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Level design based on sound analysis

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Question

Can a song bring us useful information for the creation of a video game?

Objectives

- Review the existing literature about the topic
- Using the unity engine to analyze and extract the spectrum of a song
- Analyse the song's data with data mining techniques
- Create the different mechanics that the game requires with the analyzed song.

Introduction

- There is a possibility to make a game that has music as its main character?
- This study will deal with the use of sound in game design, different approaches will be taken, using the raw data of a sound spectrogram to see what elements can be used and what is the result, in addition, processed spectrogram data through data mining techniques will also be used, clustering techniques are the mainly used.

Technologies

Unity

- Unity is a cross-platform game engine developed by Unity Technologies.

RapidMiner

- RapidMiner is a data science software platform developed by the company of the same name that provides an integrated environment for data preparation, machine learning, deep learning, text mining, and predictive analytics.

Blender

- Blender is a free and open-source 3D computer graphics software toolset used for creating animated films, visual effects, art, 3D-printed models, motion graphics, interactive 3D applications, virtual reality, and, formerly, video games.

Data Analysis

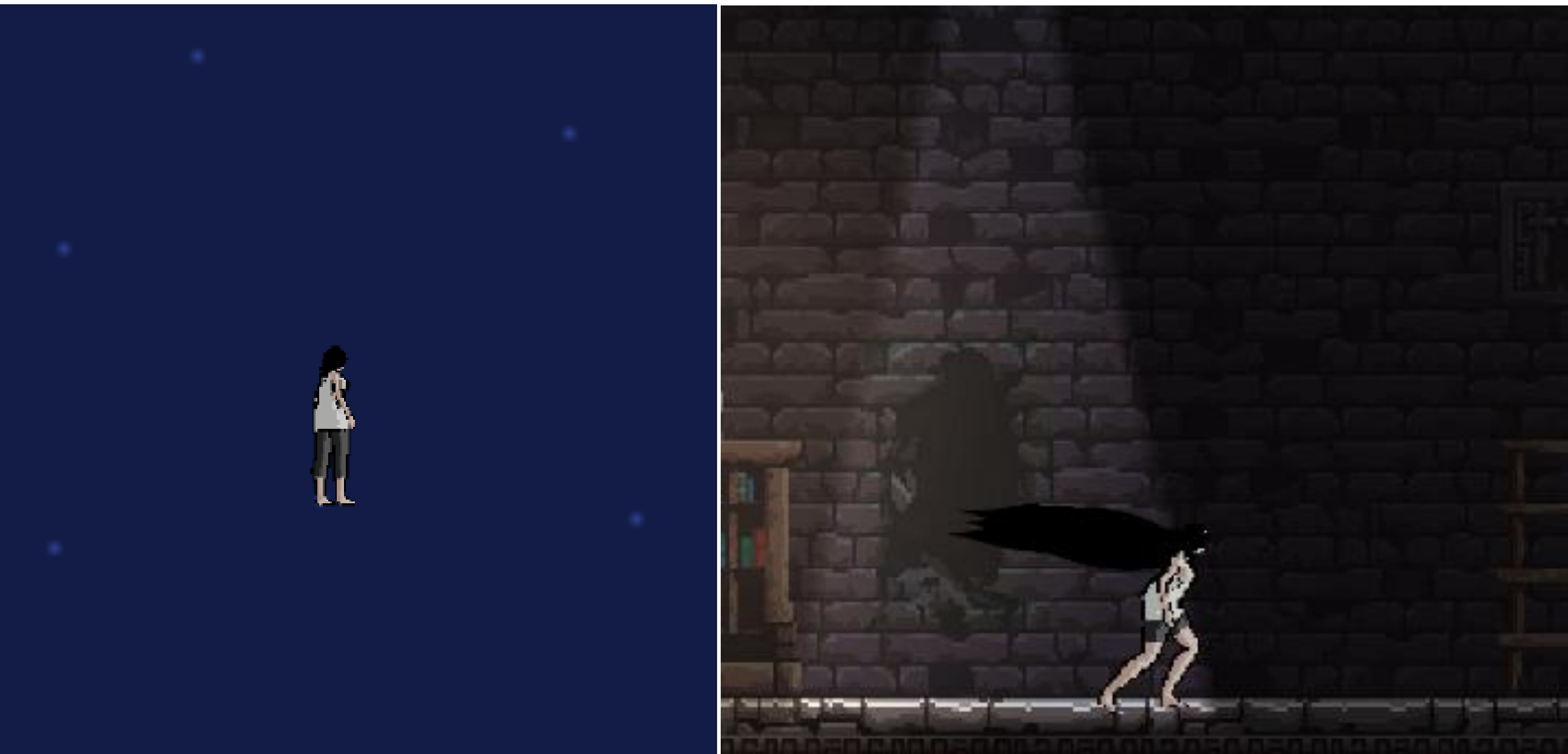
- **Raw song data**
- The raw data consists of giving a strength value to a frequency range, these ranges are divided into 128 parts, the strength and frequency values are delimited in real time because the program has to go through the song from beginning to end in time real, therefore the second of the song in which these values are measured is also recorded.
- First column is the amplitude, the second is the frequency, the third is the time and the fourth is the frame

A2				
fx 0,000000000390388				
	A	B	C	D
1	6,4E-06	0	0	1
2	3,9039E-10	1	0	1
3	3,9042E-10	2	0	1
4	1,3017E-10	3	0	1
5	3,9054E-10	4	0	1
6	7,8118E-11	5	0	1
7	1,3026E-10	6	0	1
8	5,5849E-11	7	0	1
9	3,9101E-10	8	0	1
10	4,346E-11	9	0	1
11	7,8265E-11	10	0	1
12	3,5599E-11	11	0	1
13	1,3061E-10	12	0	1
14	3,0158E-11	13	0	1
15	5,6056E-11	14	0	1
16	2,618E-11	15	0	1
17	3,929E-10	16	0	1
18	2,3129E-11	17	0	1
19	4,3726E-11	18	0	1
20	2,0734E-11	19	0	1
21	7,8858E-11	20	0	1
22	1,8794E-11	21	0	1
23	3,5925E-11	22	0	1
24	1,7203E-11	23	0	1
25	1,3204E-10	24	0	1
26	1,5863E-11	25	0	1
27	3,0546E-11	26	0	1
28	1,4729E-11	27	0	1
29	5,6894E-11	28	0	1
30	1,3751E-11	29	0	1
31	2,663E-11	30	0	1
32	1,2906E-11	31	0	1

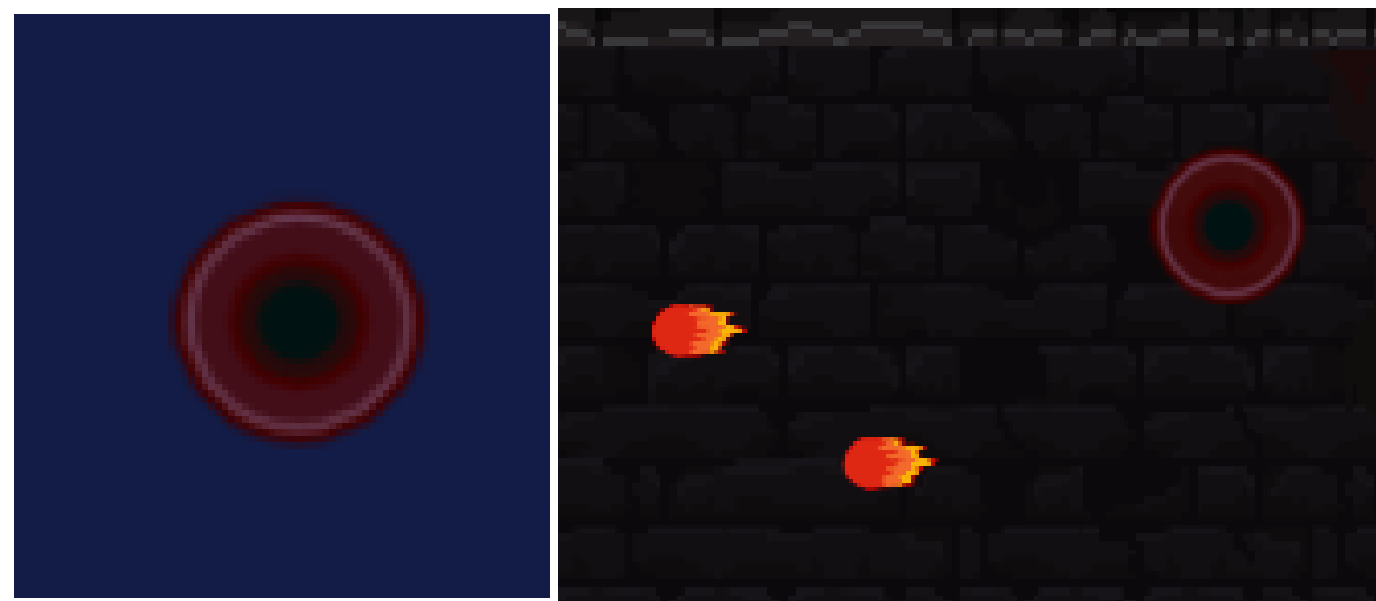
- **Process song data**
- Once the process has been carried out, it returns one of the data grouped by the clusters, these clusters group the frequency values of greater amplitude.
- Apart from the clusters, they provide other data such as the average amplitudes or powers, the average time, the predominant frequencies, useful information to generate content in the game.



In-game results



- The map is created procedurally, starts out empty and fills up over time and the speed of the level varies depending on the data provided by the analysis of the song



- There are two types of enemies, the attack pattern of one of them will be carried out taking the bpm of the song as a reference, in this way an attack will be carried out periodically and predictably, the other enemy will carry out the attack when the range of amplitude or power of the low harmonics is especially strong.

Conclusion

- The theme of music is as complex as it is interesting. Sound has many properties that make it a physical theme but at the same time stimulate people's minds to such an extent that they make it something intellectual or spiritual.
- Trying to teach a machine the to feel as those waves make us feel is impossible, but with future technology and hard work we can at least imitate it.